Chapter 2

Transportation System Extent and Condition

Introduction

The U.S. transportation system makes possible a high level of personal mobility and freight activity for the nation's 281 million residents and nearly 7 million business establishments. In 1999, over 230 million motor vehicles, transit vehicles, railroad cars, and boats were available for use on the over 4 million miles of highways, railroads, and waterways that connect all parts of the United States, the fourth largest country in the world in land area. The transportation system also includes about 213,000 aircraft and over 19,000 public and private airports (an average of about 6 per county), and over 400,000 miles of oil and gas transmission lines. This extensive transportation network supported about 4.6 trillion passenger-miles of travel in 1999 and 3.8 trillion ton-miles of commercial freight shipments in 1999.

In general, the nation's transportation infrastructure has changed very little in recent years, while the number of vehicles has grown, in some cases dramatically. Road lane-miles, for instance, have grown by about 3 percent between 1980 and 1999, while cars and light trucks have increased by 40 percent. In air transportation, the number of aircraft operated by air carriers has increased by more than 30 percent since 1990, while the number of certificated airports (those serving scheduled air carrier operations with aircraft seating more than 30 passengers) has shrunk. The heavy use of the nation's infrastructure raises the specter of deterioration. Data show, however, the nation's roads, bridges, and airport runways, in general, improved in the 1990s.

As the level of traffic continues to climb and the amount of infrastructure remains the same, improved management of the system is one method being used to keep traffic flowing. The increasing use of information technology is important not only in commercial aviation, railroading, and waterborne commerce, but also in highway transportation, transit, general aviation, and boating. Information technology enhances the capability to monitor, analyze, and control infrastructure and vehicles, and offers real-time information to system users. These technologies have a great deal of potential to help people and businesses use the transportation system more efficiently.

Transportation System Extent

The widespread availability of a large variety of transportation options brings a high level of mobility to most of the nation's residents and businesses. Tables 1 through 6 provide a snapshot of the key elements of the U.S. transportation system.

To put the system into perspective, the system's 4 million miles of roads would circle the globe

Table 1
Highways: 1999 Data (unless noted)

Public roads
- 46,567 miles of Interstate highways
- 113,983 miles of other National Highway System (NHS) roads
- 3,771,462 miles of non-NHS roads

Vehicles and use
- 132 million cars, driven 1.6 trillion miles
- 75 million light trucks, driven 0.9 trillion miles
- 7.8 million commercial trucks with 6 tires or more and combination trucks, driven 0.2 trillion miles
- 729,000 buses (all types), driven 7.7 billion miles
- 4.2 million motorcycles, driven 10.6 billion miles

Passenger and freight motor carriers
- 4,000 private motorcoach companies operating in the U.S. and Canada, 860 million passengers[1]
- 511,000 interstate freight motor carriers[2] (2000), 1.1 trillion ton-miles carried[3]

[1] American Bus Association, available at http://www.buses.org, as of Nov. 9, 2000.
[2] U.S. Department of Transportation, Federal Motor Carrier Safety Administration, *Motor Carrier Management Safety Information System Report LS50B901* (Washington, DC: March 2000).
[3] Eno Foundation, Inc., *Transportation in America, 1999* (Washington, DC: 2000).

SOURCE: U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 1999* (Washington, DC: 2000), tables HM-14 and HM-20.

Table 2
Air: 1999 Data (unless noted)

Airports (2000)
- 5,317 public-use airports
- 13,964 private-use airports

Airports serving large certificated carriers[1]
- 29 large hubs (69 airports), 458 million enplaned passengers
- 31 medium hubs (48 airports), 96 million enplaned passengers
- 56 small hubs (73 airports), 39 million enplaned passengers
- 577 nonhubs (604 airports), 17 million enplaned passengers

Aircraft
- 8,111 certificated air carrier aircraft,[2] 5.1 billion domestic miles flown[3]
- 205,000 active general aviation aircraft[4] (1998), 3.9 billion statute-miles flown[5] (1997)

Passenger and freight companies[3]
- 81 carriers
- 588 million domestic revenue passenger enplanements
- 13.9 billion domestic ton-miles of freight

Certificated air carriers (domestic and international)
- Majors: 13 carriers, 650,000 employees, 552 million revenue passenger enplanements
- Nationals: 30 carriers, 66,000 employees, 87 million revenue passenger enplanements
- Regionals: 38 carriers, 9,000 employees, 11 million revenue passenger enplanements

[1] U.S. Department of Transportation, Bureau of Transportation Statistics, Office of Airline Information, *Airport Activity Statistics of Certificated Air Carriers, 12 Months Ending December 31, 1999* (Washington, DC: 2001).
[2] Aerospace Industries Association, *Aerospace Facts and Figures* (Washington, DC: 1999/2000).
[3] U.S. Department of Transportation, Bureau of Transportation Statistics, Office of Airline Information, *Air Carrier Traffic Statistics* (Washington, DC: 1999).
[4] U.S. Department of Transportation, Federal Aviation Administration, *General Aviation and Air Taxi Activity and Avionics Survey, Calendar Year 1998* (Washington, DC: 2000).
[5] U.S. Department of Transportation, Federal Aviation Administration, *General Aviation and Air Taxi Activity and Avionics Survey, Calendar Year 1997*, FAA-APO-99-4 (Washington, DC: 1999).

SOURCE: U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics 2000* (Washington, DC: 2001).

more than 157 times, its rail lines 7 times, and its oil and gas pipelines 56 times. The average distance traveled by each car and light truck annually (about 12,000 miles) equals a journey nearly halfway around the world, or added together, about one-tenth the distance to the nearest star outside our solar system.

The capacity of the air and transit systems in the United States is also phenomenal. There are more than enough seats on airplanes operated by U.S. air carriers to seat the entire population of Delaware (population 780,000). And the number of cars in the New York City subway system alone is more than large enough for the entire population of Baton Rouge, Louisiana (population about 200,000), to have a seat at the same time.

Table 3
Rail: 1999 Data (unless noted)

Miles of road operated
120,986 miles by major (Class I) railroads[1]
21,250 miles by regional railroads[1]
28,422 miles by local railroads[1]
22,741 miles by Amtrak[2]

Equipment[1]
1.4 million freight cars
20,256 freight locomotives in service

Freight railroad firms[1]
Class I: 8 systems, 177,557 employees, 1.4 trillion revenue ton-miles of freight carried
Regional: 36 companies, 11,372 employees
Local: 510 companies, 12,454 employees

Passenger (Amtrak)[2]
25,000 employees, 1,894 passenger/other cars
378 locomotives, 22.5 million passengers carried (FY 2000)

[1] Association of American Railroads, *Railroad Facts: 2000 Edition* (Washington, DC: 2000).
[2] National Railroad Passenger Corp., *Annual Report 2000* (Washington, DC: 2000), also available at http://www.amtrak.com/news/00annualrpt.pdf, as of April 2001.

SOURCE: U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics 2000* (Washington, DC: 2001).

Table 4
Transit: 1999 Data (unless noted)

Vehicles[1] **(1998)**
55,661 buses (also included in buses under highway), 17.9 billion passenger-miles
11,357 heavy and light rail, 13.4 billion passenger-miles
5,535 commuter rail, 8.7 billion passenger-miles
97 ferries, 280 million passenger-miles
20,042 demand responsive, 513 million passenger-miles
7,654 other vehicles, 654 million passenger-miles

Transit agencies[2]
554 federally funded urbanized area agencies
1,074 federally funded rural agencies
3,594 federally funded specialized transportation agencies
753 other agencies
321,000 employees

[1] U.S. Department of Transportation, Federal Transit Administration, National Transit Database 1998, available at http://www.fta.dot.gov/ntl/databases/index.html, as of Oct. 23, 2000.
[2] American Public Transportation Association, *Transit Factbook 1999* (Washington, DC: 1999).

SOURCE: U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics 2000* (Washington, DC: 2001).

(continued on next page)

Table 5
Water: 1999 Data (unless noted)

U.S.-flag fleet

Great Lakes: 674 vessels,[1] 57 billion ton-miles (domestic commerce)[2]
Inland: 33,970 vessels,[1] 305 billion ton-miles (domestic commerce)[2]
Ocean: 7,122 vessels,[1] 293 billion ton-miles (domestic commerce)[2]
Recreational boats: 12.6 million numbered boats[3] (1998)

Commercial facilities[4]

Great Lakes: 619 deep-draft, 144 shallow-draft
Inland: 2,376 shallow-draft
Ocean: 4,050 deep-draft, 2,118 shallow-draft

[1] U.S. Army Corps of Engineers, Water Resources Support Center, *Waterborne Transportation Lines of the United States: Calendar Year 1999* (Fort Belvoir, VA: 2000), also available at http://www.wrsc.usace.army.mil/ndc/veslchar.htm, as of April 2001.
[2] U.S. Army Corps of Engineers, Water Resources Support Center, *Waterborne Commerce of the United States 1999* (Fort Belvoir, VA: 2001). Domestic ton-miles include commerce among the 50 states, Puerto Rico, the Virgin Islands, Guam, American Samoa, Wake Island, and the U.S. Trust Territories. Domestic total does not include cargo carried on general ferries, coal and petroleum products loaded from shore facilities directly into bunkers of vessels for fuel, transport of less than 100 tons of government materials on government-owned equipment in support of U.S. Army Corps of Engineers projects. Fish are also excluded from internal (inland) domestic traffic.
[3] U.S. Department of Transportation, U.S. Coast Guard, *Boating Statistics–1998* (Washington, DC: 2000).
[4] U.S. Army Corps of Engineers, Navigation Data Center, *Geographic Distribution of U.S. Waterway Facilities,* available at http://www.wrsc.usace.army.mil/ndc/fcgeodis.htm, as of January 2001.

SOURCE: U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics 2000* (Washington, DC: 2001).

Table 6
Pipeline: 1999 Data (unless noted)

Oil[1]

Crude lines: 86,000 miles, 336 billion ton-miles
Product lines: 91,000 miles, 287 billion ton-miles

Natural gas (estimates)[2]

Transmission: 254,000 miles of pipe
Distribution: 981,000 miles of pipe, 86 companies, 142,000 employees

[1] Eno Foundation, Inc., *Transportation in America, 1999* (Washington, DC: 2000).
[2] American Gas Association, *Gas Facts* (Washington, DC: 1999).

SOURCE: U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics 2000* (Washington, DC: 2001).

Restructuring and Consolidation of Transportation Industries

Aviation

The aviation industry has grown dramatically and changed since the Airline Deregulation Act of 1978. It has experienced consolidation, while at the same time, new-entrant, low-fare competitors have emerged. Some older, established airlines, such as Eastern, National, and Pan American, have disappeared, while others, such as Southwest Airlines, a former intrastate carrier, have become major airlines. As a result, the number of major airlines has changed relatively little since 1980, even though airlines have come and gone.

Deregulation created major opportunities for smaller airlines, known as nationals and regionals. Before deregulation, these smaller airlines tended to operate on the fringes of the service areas of the large commercial air carriers. The typical smaller airline was a fixed-base operator that provided scheduled air service to small communities using small aircraft that seated fewer than 30 passengers.

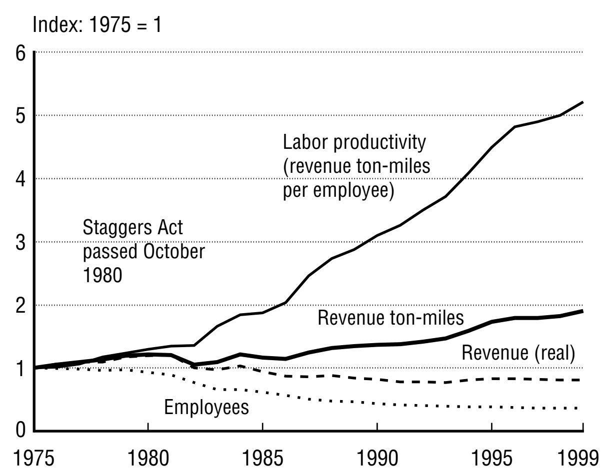
After deregulation, national and regional airlines became increasingly important sources for connecting traffic to major carriers. These connections led to the next significant trend to evolve from deregulation—the development of "code-sharing" agreements between the major and nonmajor air carriers. Code-sharing is a common industry practice in which one airline offers services in its own name for a particular city-pair, but some, or all, of the transportation is provided by another carrier. More recently, the larger air carriers began purchasing their smaller partners. The close relationship between the regional, national, and major air carriers continues to shape the industry today.

In 1999, the national and large regional carriers enplaned 84 million people, up from 51 million in 1980. The share of passengers enplaned by majors has increased over this period, however, going from 81 percent to 85 percent.

Rail

The freight railroad industry has consolidated greatly over the past 25 years. Today, there are only 8 Class I (major) railroads in the United States, down from 73 in 1975. Between 1975 and 1999, the Class I railroads increased their traffic (measured in ton-miles) by 90 percent, while their network (miles of road owned) declined by about 50 percent and the number of employees declined by about 60 percent. During this same period, Class I railroad industry labor productivity, measured by revenue ton-miles per employee, soared (figure 1). In 1975, Class I railroads owned approximately 192,000 miles of road (route-miles). By 1999, Class I companies owned about 99,000 miles of rail line. Many of

Figure 1
Class I Railroad Performance Indices: 1975–1999



SOURCE: Association of American Railroads, *Railroad Facts* (Washington, DC: Annual issues).

the lines have been sold to new, aggressive regional and short-line railroads (Class II and III), especially since the Staggers Act of 1980 that encouraged sales to small railroads rather than abandonment. Today, these railroads operate a total of 50,000 miles of road [2].

Water

During the 1990s, the shipping industry underwent major consolidation in an effort to improve its efficiency and productivity. Some of the important mergers were P&O Container and Nedlloyd, Neptune Orient and APL Ltd., and Sealand and Maersk. Liner carriers[1] are currently using vessel-sharing arrangements with other carriers to improve productivity. As a result, individual companies have less need to provide direct services to multiple ports. Carriers can move cargo through a limited number of hub ports and use other modes, such as train, air, truck, or vessel feeder services, to connect the hub with the cargo's ultimate destination or origin. In the United States, the ports of Long Beach and Los Angeles in California are the largest container hub ports in North America.

The U.S. Congress deregulated the shipping industry in 1988 when it passed the Ocean Shipping Reform Act (OSRA). OSRA allows shippers and ocean carriers to enter, for the first time, into confidential service contracts that must be filed only with the Federal Maritime Commission. Previously, a system of conferences (voluntary associations of ocean carriers) set rates. Under earlier Acts, the carriers had to share rate information with all other shippers, who could then demand similar rates from ocean carriers. Now rates may be negotiated on a case-by-case, one-to-one basis between shippers and carriers. OSRA strengthens provisions that prohibit unfair foreign shipping practices and provides greater protection against discriminatory actions. The Act could also lead to another round of consolidation in the industry.

Consolidation in the cruise line industry, through acquisitions and mergers, has provided the top companies with more financial strength and marketing muscle to promote their ships and control costs, contributing to the stability of the industry in the late 1990s. For instance, in 1998, the top four North American cruise lines controlled 82 percent of the North American cruise capacity, up from 61 percent in 1995. In fact, these companies controlled an even larger share of the market because their newer vessels tend to sail at higher percentages of capacity than those of smaller lines [3].

Motor Carriers

The motor carrier industry comprises truck and bus companies. In the mid-1970s, the motor carrier industry was regulated by the Interstate Commerce Commission (ICC), which controlled routes of service and rates through its rate bureaus. Startup companies were required to prove that their plan to provide new service was in the public's best interest. Only a limited number of truck and bus companies were authorized to provide service—18,000 truck companies in 1975 compared with nearly 500,000 companies in operation today [6]. Responding to concerns about the economic inefficiency of the trucking industry, ICC loosened the entry standards in the late 1970s. The Motor Carrier Act of 1980 further eased barriers to entry. In the early 1980s, the use of private carriers ("in-house" trucking fleets) declined as companies chose to take advantage of lower rates and improved service by for-hire carriers. Of the nearly 500,000 trucking companies providing service today, most have 6 or fewer trucks (table 1). About 3,200 carriers have more than 100 trucks [5].

Bus companies, too, were given authority to set rates and determine routes as a result of deregulation in 1982. Economic deregulation spurred strategic reorganization of the bus industry, creating conditions for improved serv-

[1] A cargo-carrying ship operated between specified ports on a regular basis for an advertised price, versus a chartered ship that operates for single deliveries to a variety of ports.

Table 1
Active Interstate Motor Carriers by Fleet Size: 2000

Fleet size (number of power units)	Number of carriers: Hazardous materials	Passenger carriers	All others	Total
1	9,083	5,927	204,269	**219,279**
2–6	17,249	4,535	139,021	**160,805**
7–20	9,028	1,470	32,058	**42,556**
21–100	5,194	832	9,799	**15,825**
101–5,000	1,644	147	1,417	**3,208**
Over 5,000	17	1	8	**26**
Unspecified	1,410	2,360	80,587	**84,357**
Total	**43,625**	**15,272**	**467,159**	**526,056**

NOTE: Data include intrastate hazardous materials carriers.

SOURCE: U.S. Department of Transportation, Federal Motor Carrier Safety Administration, *Motor Carrier Management Information System Report,* LS50B901 (Washington, DC: March 2000).

ices. In certain cases, however, deregulation resulted in diminished services.

Greyhound and Trailways merged in 1987 to provide a larger network of intercity bus service. This strategic agreement resulted in improved intercity service and better scheduling and fare information. In addition, new, smaller regional carriers have started providing service to specialized niche markets. These carriers not only serve geographic markets, but also sectors of the population, such as senior citizens, metropolitan commuters, vacation travelers, or luxury travelers. About 4,000 private motorcoach companies now operate in the United States and Canada, offering charters, tours, regular route service, and other bus services [1].

Following deregulation and with increasing competition from airlines and automobiles, bus companies eliminated many unprofitable routes and stops, particularly in rural areas. In 1982, more than 11,000 locations were served nationwide, down from 16,000 in the early 1970s [4]. Today, the number of locations served has fallen to just about 5,000, with much of the curtailed service in rural areas. The Transportation Equity Act for the 21st Century provides support for the intercity bus needs of rural residents.

Sources

1. American Bus Association, *Industry Profile: Motorcoach Industry Facts,* available at http://www.buses.org, as of July 26, 2000.
2. Association of American Railroads, *Railroad Facts* (Washington, DC: 2000).
3. Mathiesen, Oivind (ed.), *Cruise Industry News 1998 Annual* (New York, NY: Cruise Industry News, 1998).
4. U.S. General Accounting Office, *Surface Transportation: Availability of Intercity Bus Service Continues To Decline,* GAO/RECD-92-126 (Washington, DC: 1992).
5. U.S. Department of Transportation, Federal Motor Carrier Safety Administration, *Motor Carrier Management System Report LS50B901* (Washington, DC: March 2000).
6. ____. personal communication, Aug. 1, 2000.

Information Technology Use

From the telegraph used by railroads in the 19th century to radio and radar used in ships and planes at the beginning of the 20th century, information technology (IT) has enhanced the capabilities of our transportation systems. In recent years, these technologies have been integrated into all modes of transportation. Highway and transit applications of IT now are joining the other modes as new technology allows drivers to "navigate" roads.

Intelligent transportation systems (ITS) comprise a broad range of technologies, including those in the IT category, and help improve the efficiency, effectiveness, and safety of transportation. Travelers can obtain information and guidance from electronic surveillance, communications channels, and traffic analysis. ITS also boosts the capability to monitor, route, control, and manage information to facilitate travel.

The variety of technologies and approaches across the ITS spectrum, however, complicates the tracking of deployment. The U.S. Department of Transportation, Federal Highway Administration's ITS Joint Program Office conducted two surveys, in 1997 and 1999, to gauge urban implementation in 75 metropolitan areas in the United States [2]. The surveys collected data on deployment for nine ITS infrastructure components for highways, transit, and highway-rail grade crossings within the boundaries of metropolitan planning organizations (MPOs).

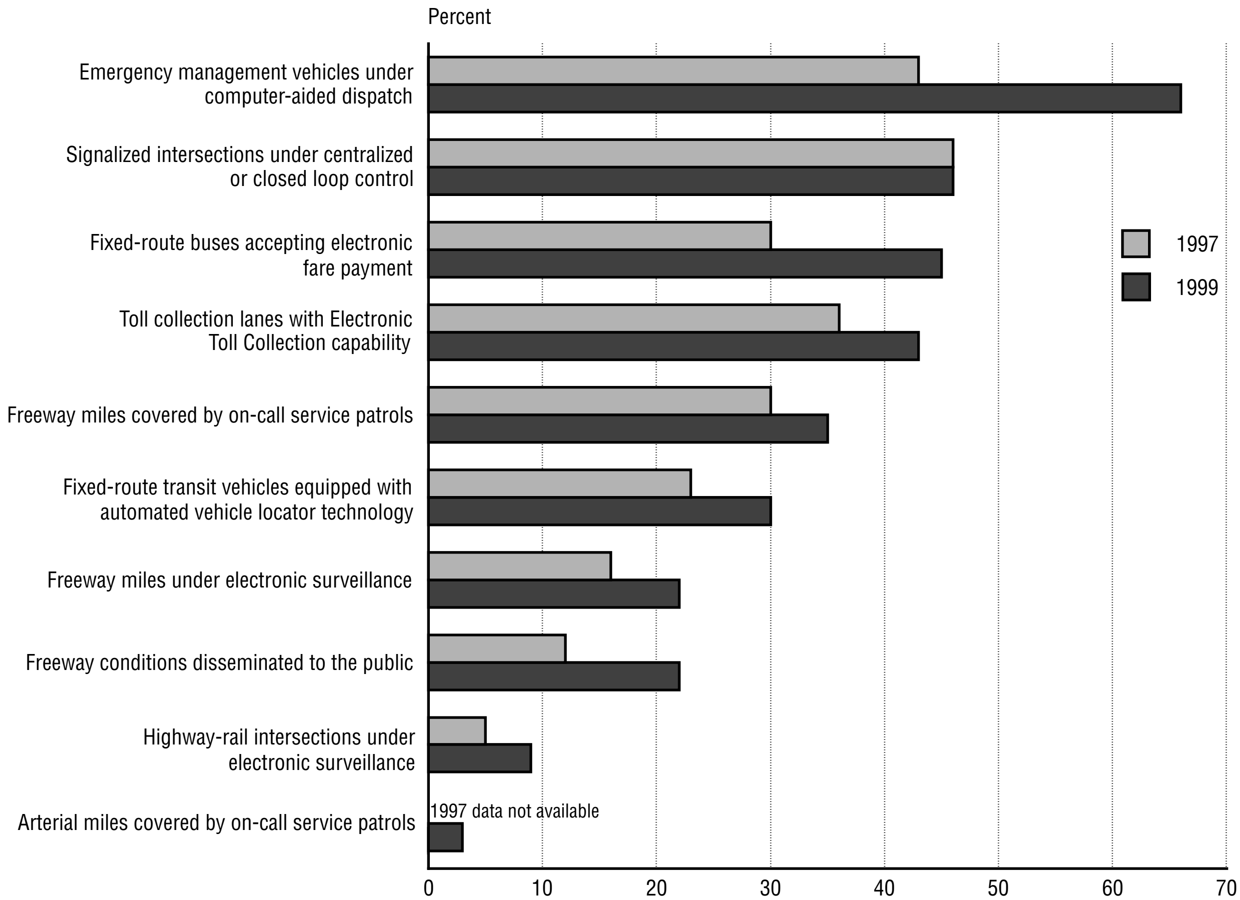
A single ITS component may utilize several technologies or approaches. For instance, electronic toll collection (ETC) technologies automatically collect payments through the application of in-vehicle, roadside, and communications technologies. Over 43 percent of the metropolitan areas surveyed had toll collection lanes with ETC capacity, up from 36 percent in 1997 [2].

Multiple ETC technology deployment highlights the growing importance of integrating ITS. Beyond measuring fixed ITS assets like vehicles, the ITS Joint Program Office also studies the integration among agencies operating the infrastructure. Federal officials define ITS integration as the transfer of information between three types of organizations: state departments of transportation, local governments, and transit agencies.

Traffic signal control and electronic toll collection are two of the top three highway ITS technologies currently being deployed (figure 1). These technologies directly benefit travelers by smoothing out trips on toll roads and signaled arterial roads. Highway-rail grade crossings have one of the lowest rates of deployment penetration, but a major federal initiative is providing funds to address this area (see the section on high-speed rail corridors elsewhere in this chapter).

The Global Positioning System (GPS) is being used in all transportation modes (even walking), although to what overall extent is uncertain. Thirty percent of the surveyed metropolitan areas showed some deployment of automatic vehicle location devices in fixed-route transit vehicles [2]. GPS is not only used for commercial aviation, but it is also used for general aviation. About 70 percent of corporate and over half of business-use aircraft have GPS devices, compared with about 40 percent of personal-use aircraft [1]. In 1996, the U.S. Coast Guard brought its Maritime Differential GPS (DGPS) online. Reference stations located every 200 miles along the coast and major rivers allow ships with the proper GPS receiving equipment to identify their positions within 5 to 10 meters, compared with 100 meters for other positioning systems. This is an important navigational aid, as some channels are less than 100 meters wide. The U.S. Department of Transportation is

Figure 1
ITS Infrastructure Deployment in 75 Metropolitan Areas: 1997 and 1999



SOURCE: U.S. Department of Transportation, Federal Highway Administration, ITS Joint Program Office, *Tracking the Deployment of the Integrated Metropolitan Transportation Systems Infrastructure in the USA: FY 1999 Results*, May 2000, available at www.itsdocs.fhwa.dot.gov, as of Feb. 8, 2001.

now implementing Nationwide DGPS to bring the same positioning accuracy to all parts of the continental United States and Alaska.

Railroads are developing positive train control (PTC) systems that will use nationwide DGPS to provide precise positioning information. PTC can prevent overspeed accidents and collisions between trains and between trains and maintenance-of-way crews. PTC can also improve the efficiency of railroad operations by reducing train over-the-road delays and increasing running time reliability, track capacity, and asset utilization. [3].

Sources

1. U.S. Department of Transportation, Federal Aviation Administration, General Aviation and Air Taxi Survey, 1996, available at http://api.hq.faa.gov/ga96/gatoc.htm, as of Dec. 5, 2000, table 7.2.
2. U.S. Department of Transportation, Federal Highway Administration, ITS Joint Program Office, *Tracking the Deployment of the Integrated Metropolitan Transportation Systems Infrastructure in the USA: FY 1999 Results,* May 2000, available at http://www.itsdocs.fhwa.dot.gov, as of Feb. 8, 2001.
3. _____. “What Is Positive Train Control?” available at http://frarnd.volpe.dot.gov, as of Dec. 4, 2000.

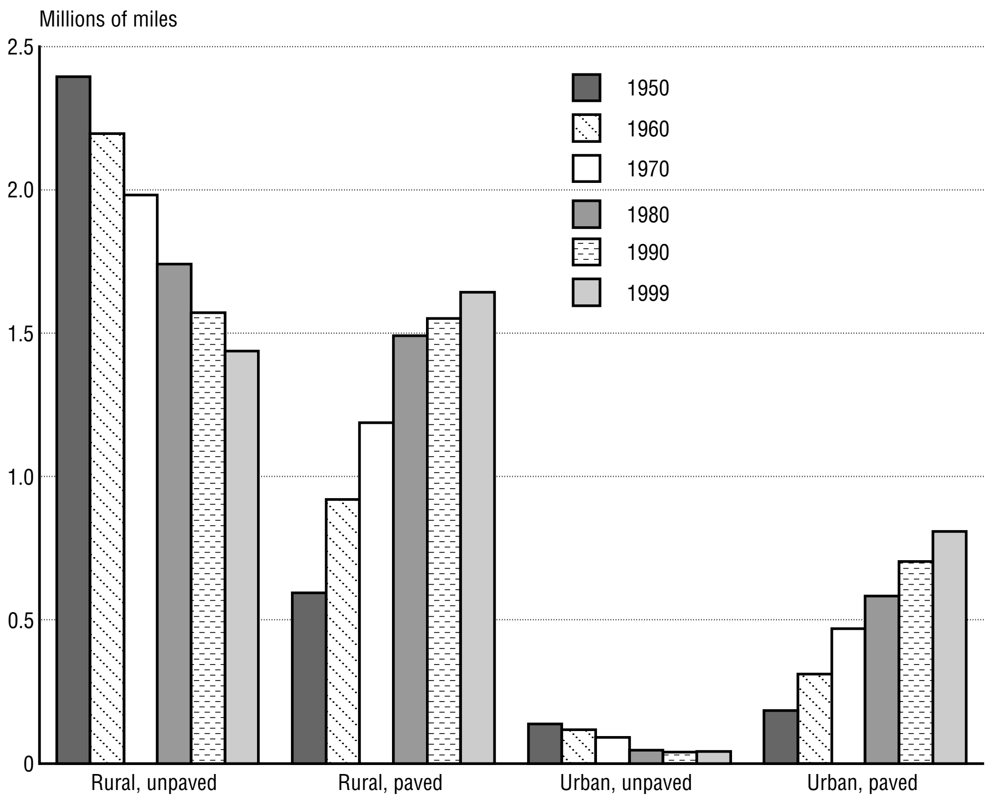
Roads

Road building and widening continue to slowly increase the extent of the public road system and the length of lane-miles open to the public. Since 1980, miles of public road increased only about 1.5 percent, although lane-miles increased twice as much (3.2 percent). Paved roadways constituted about 62 percent of all highway mileage in 1999, up from 54 percent in 1980 and 24 percent in 1950. Nearly all of the public roads in urban areas are paved. However, about half of the miles of rural public roads are unpaved, accounting for 97 percent of total unpaved public road miles—much the same ratio as in 1980 (figure 1) [1].

Source

1. U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics* (Washington, DC: Annual editions).

Figure 1
Urban and Rural Roadway Mileage by Surface Type: 1950–1999



SOURCES: U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics* (Washington, DC: Annual editions), table HM-12.
_____. *Highway Statistics Summary to 1995* (Washington, DC: 1997), table HM-212.

U.S. Vehicle Fleet

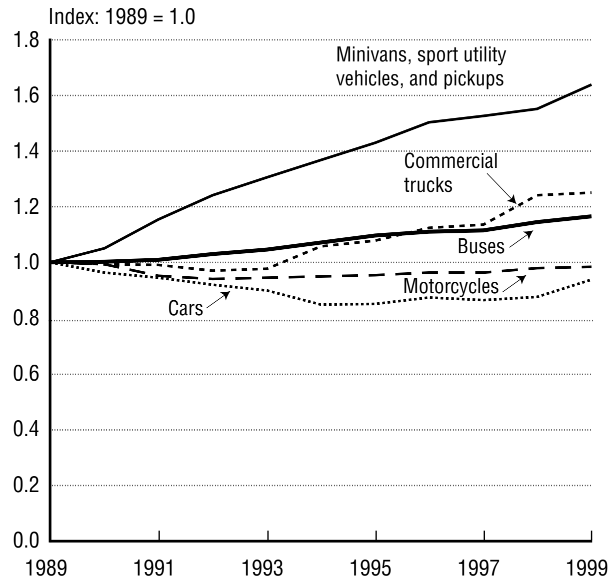
Between 1989 and 1999, the most noteworthy development in the U.S. vehicle fleet was the rapid growth in the number of registered light-duty trucks, including minivans, pickups, and sport utility vehicles (figure 1). During this period, the number of these vehicles grew from nearly 46 million to over 75 million, an increase of about 64 percent. This category now accounts for 34 percent of the total U.S. fleet, up from 23 percent in 1989. Fueled by the rapid increase in the number of light-duty trucks, the total U.S. fleet grew to nearly 220 million vehicles in 1999, an 11 percent increase over the 198 million vehicles registered in 1989 [1].

In contrast to the rapid growth of light-duty trucks, the number of other types of vehicles remained relatively steady, while the shares declined in some cases. The number of cars, though still 60 percent of the total fleet at nearly 132 million vehicles in 1999, decreased slightly over the past 10 years, and accounted for nearly 10 percent less of the total fleet in 1999 than in 1989. Over the same period, the number of large trucks and buses increased at roughly the same rate as the total U.S. fleet, while motorcycle registrations declined somewhat [1].

Source

1. U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 1999* (Washington, DC: 2001).

Figure 1
Highway Vehicle Trends: 1989–1999



SOURCES: 1991–1995: U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics Summary to 1995* (Washington, DC: 1997), tables MV-201 and VM201a.
1996–1997: ____. *Highway Statistics 1997* (Washington, DC: 1998), table VM-1.
1998–1999: ____. *Highway Statistics 1999* (Washington, DC: 2000), table VM-1.

High-Speed Rail Corridors

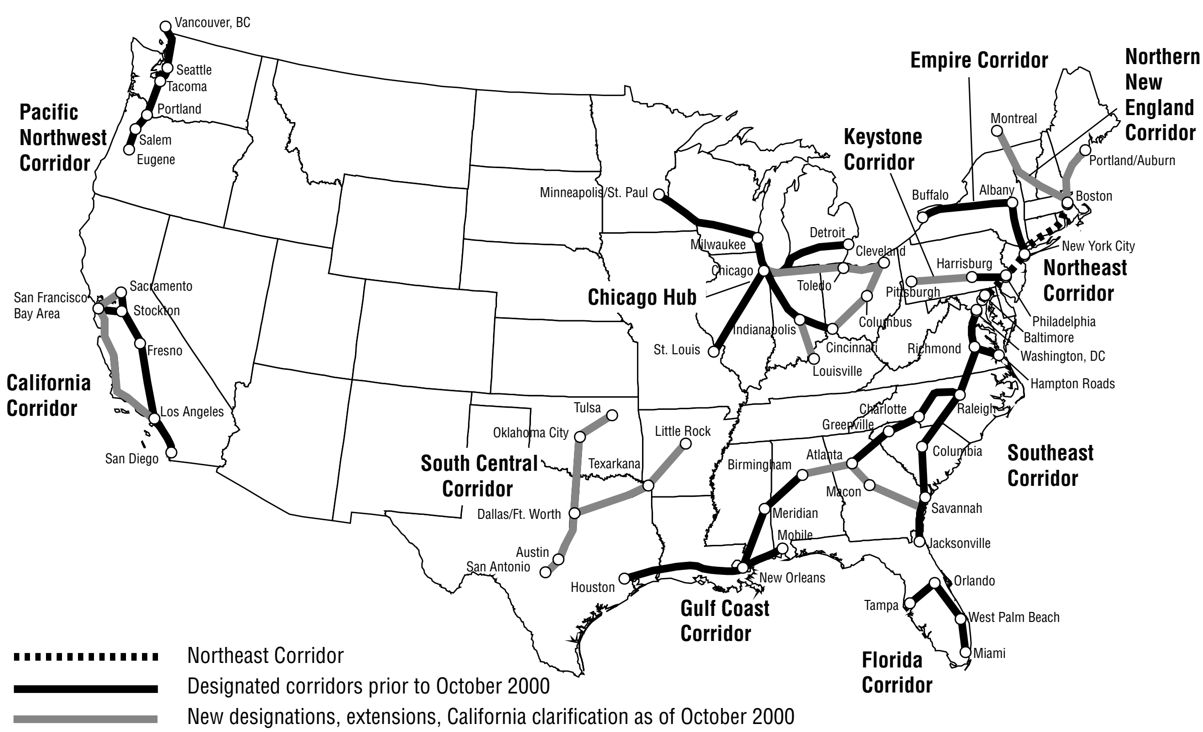
In recent years, high-speed rail (HSR) service for intercity passengers has experienced renewed interest). HSR technologies allow trains to travel at top speeds of 90 to 300 miles per hour (the highest speeds can be achieved by trains powered by magnetic levitation). Several parts of the country have HSR plans, and a number of rail corridors are under development.

In May 2000, the U.S. Department of Transportation announced grants totaling $5.3 million to five HSR corridors to eliminate hazards at public and private highway-rail grade crossings [1]. Funds can be used to close crossings, install advanced train control or traffic control systems, and upgrade warning devices, among other things. The five initially designated corridors were the Pacific Northwest Corridor, the Chicago Hub Corridor, the Gulf Coast Corridor, Southeast Corridor, and the Empire Corridor. In October 2000, the program was extended (see map below).

Sources

1. Slater, Rodney, Secretary of Transportation, U.S. Department of Transportation, "Funding for Grade Crossing Hazard Elimination Programs in Designated High-Speed Rail Corridors," May 12, 2000.
2. _____. "U.S. Transportation Secretary Slater Designates Two New High-Speed Rail Corridors, press release, Oct. 11, 2000, available at http://www.dot.gov/affairs/fra2000.htm, as of June 2001.

Designated High-Speed Rail Corridors: 2000



SOURCE: U.S. Department of Transportation, Federal Railroad Administration, 2000.

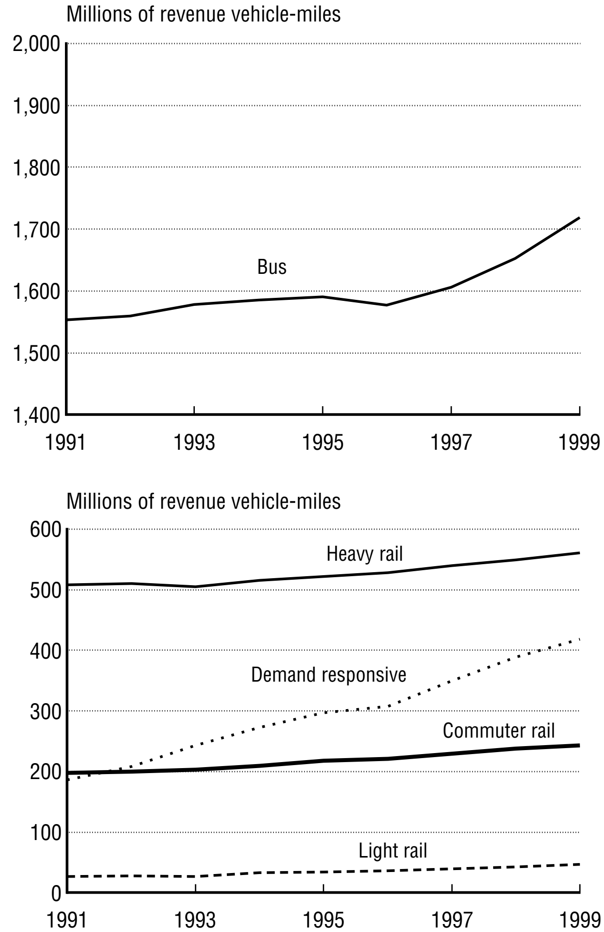
Urban Transit

Urban transit is a complex mix of heavy, light, and commuter rail; buses and demand responsive vehicles; ferries; and other less prevalent types such as inclined planes, trolley buses, and automated guideways. The capacity of this mode, measured by revenue vehicle-miles of service provided, grew by nearly 30 percent between 1991 and 1999 to over 3 billion miles. The U.S. population grew by 8 percent over this same period. The largest transit modes, bus and heavy rail, showed the slowest growth during this period (about 10 percent), while demand responsive transit grew the fastest (125 percent) (figure 1). Among rail modes, both light rail and commuter rail have seen substantial increases in service provided over this period, 77 percent and 23 percent, respectively [1].

The number of urban transit vehicles in rush hour service increased 26 percent between 1991 and 1999, with the number of buses rising 10 percent from 42,900 to 47,100, and rail vehicles moving up 8 percent from 12,900 to 13,900. The largest percentage gain occurred for commuter rail vehicles—17 percent, compared with 3 percent for heavy rail and 12 percent for light rail. Vehicles used in demand-responsive service soared nearly 90 percent from 8,400 in 1991 to 15,900 in 1999 [2].

The Federal Transit Administration assesses the condition of transit vehicles using a rating scale from 5.0 to 0.0 (excellent to poor condition).[1] Between 1987 and 1997, the average condition of most types of buses remained about the same, although the condition of vans improved (table 1). Most transit rail vehicles

Figure 1
Revenue Vehicle-Miles by Urban Transit Mode: 1991–1999



NOTE: Other modes, including ferryboat, trolley bus, and automated guideway, are not shown.

SOURCE: U.S. Department of Transportation, Federal Transit Administration, National Transit Database, Various years.

[1] These ratings come from the Transit Economic Requirements Model, which uses nonlinear deterioration curves developed from transit asset condition and replacement records.

Table 1
Condition of Transit Vehicles: 1987–1997

	Rating	
Type of vehicle	**1987**	**1997**
Articulated buses	3.1	2.7
Full-size buses	3.0	3.0
Mid-size buses	3.0	3.0
Small buses	3.3	3.4
Vans	3.2	3.5
Locomotives	4.5	4.5
Heavy railcars	4.7	3.9
Unpowered commuter railcars	4.2	4.2
Powered commuter railcars	4.8	3.7
Light-rail vehicles	4.5	4.6

Key to ratings: 0.0–1.99 = poor; 2.0–2.99 = substandard; 3.0–3.99 = adequate; 4.0–4.9 = good; 4.9–5.0 = excellent.

SOURCE: U.S. Department of Transportation, Federal Highway Administration and Federal Transit Administration, *1999 Status of the Nation's Surface Transportation System: Condition and Performance* (Washington, DC: 2000).

were in better condition than buses, but heavy railcars and powered commuter railcars showed notable deterioration over this period [1].

Sources

1. U.S. Department of Transportation, Federal Highway Administration and Federal Transit Administration, *1999 Status of the Nation's Surface Transportation System: Condition and Performance* (Washington, DC: 2000).
2. U.S. Department of Transportation, Federal Transit Administration, National Transit Database, various years.

U.S.-Flag Vessels

More than 41,000 U.S.-flag vessels were available for service in U.S. maritime trade as of December 1999 [1], and 80 percent were in use that year. The segments of the U.S.-flag fleet with the highest percentage of operating vessels were dry bulk vessels, dry cargo barges, and tank barges (table 1). Barges operate primarily on the U.S. inland waterways and carry more than 90 percent of that tonnage [2]. Tankers, on the other hand, provide service primarily on the U.S. coastal waterways (table 2).

Vessel owners have been reflagging their ships to foreign registries in order to reduce operating costs (e.g., higher wages of U.S. crews). In addition, major U.S. vessel owners and operators have, in recent years, merged with or were acquired by foreign companies.

Table 1
U.S.-Flag Vessels: Available vs. Operating, by Vessel Type: 1999

Vessel type	Vessels available	Vessels operating	Percent operating	Total operating companies
Self-propelled	**8,379**	**4,747**	**57**	**1,001**
Dry cargo (total)	695	448	65	135
Dry bulk	68	57	84	15
Containership	74	49	66	3
General cargo	320	186	58	92
Specialized	233	156	67	41
Passenger	970	599	62	285
Offshore support	1,470	719	49	120
Tanker	142	113	80	41
Towboat	5,098	2,867	56	670
Nonself-propelled	**33,387**	**28,272**	**86**	**467**
Dry cargo (total)	29,414	24,962	87	313
Tank barge (total)	3,973	3,310	84	200

NOTE: Totals are greater than the sum because of unclassified vessels.

SOURCE: U.S. Army Corps of Engineers, Water Resources Support Center, *Waterborne Transportation Lines of the United States, Calendar Year 1999, Volume 1–National Summaries* (New Orleans, LA: Dec. 31, 2000).

Table 2
Selected U.S. Vessels Available to Operate: By Region, as of December 31, 1999

Vessel type	Atlantic, Gulf & Pacific Coasts	Mississippi River System & Gulf Intracoastal Waterway	Great Lakes System
Self-propelled			
Dry cargo	1,314	1,376	220
Tankers	135	3	4
Nonself-propelled (barges)			
Dry cargo	3,095	26,031	257
Tank barge	629	3,324	20

SOURCE: U.S. Army Corps of Engineers, Water Resources Support Center, *Waterborne Transportation Lines of the United States, Calendar Year 1999, Volume 1–National Summaries* (New Orleans, LA: Dec. 31, 2000).

About 42 percent of the U.S. fleet is more than 20 years old (table 3). Over the next few years, many vessels in all segments will need to be replaced or rebuilt, potentially increasing activity for U.S. shipyards. In addition, approximately one-third of the self-propelled U.S. domestic fleet is more than 25 years old. While the high cost of building in U.S. shipyards may limit replacement in some segments, there are encouraging prospects in others, such as the increasing use of articulated tug/barge units as an alternative to tankers.

Sources

1. U.S. Army Corps of Engineers, Navigation Data Center, "The U.S. Waterway System—Transportation Facts," December 1999.
2. U.S. Department of Transportation, Bureau of Transportation Statistics, Maritime Administration, and U.S. Coast Guard, *Maritime Trade and Transportation 99,* BTS99-02 (Washington, DC: 1999).

(continued on next page)

Table 3
Age of the U.S.-Flag Vessels: As of December 31, 1999[1]

Vessel type	Number	Age (percentage of total for each vessel type)[2]					
		≤ 5	6–10	11–15	16–20	21–25	> 25
Vessels (total)[3]	**41,766**	**19.1**	**9.4**	**4.2**	**24.3**	**18.0**	**24.6**
Self-propelled (total)	**8,379**	**9.1**	**5.4**	**6.0**	**23.5**	**17.4**	**38.4**
Dry cargo	695	8.6	7.1	14.0	21.0	14.2	35.0
Tanker	142	8.5	2.1	8.5	24.6	21.1	35.2
Towboat	5,098	5.9	2.7	2.9	21.6	18.7	48.0
Passenger[4]	970	14.8	15.1	18.9	12.4	9.8	29.1
Offshore supply	1,470	16.7	7.8	4.1	38.8	19.3	13.0
Barge (total)	**33,387**	**21.6**	**10.5**	**3.8**	**24.4**	**18.2**	**21.1**
Dry covered	13,477	27.4	6.7	0.8	33.7	19.2	12.2
Dry open	9,146	22.5	17.5	7.6	22.2	15.0	15.1
Lash/SEABEE[5]	1,796	0.0	16.0	6.2	2.0	43.9	31.9
Deck	4,842	17.9	8.2	6.3	16.0	11.0	38.0
Other dry cargo[6]	153	7.2	5.2	7.2	24.2	11.1	37.3
Single hull tank	685	3.5	1.9	1.9	19.3	11.4	61.9
Double hull tank	2,621	16.6	10.4	0.8	19.0	21.6	31.7
Other tank[7]	667	16.0	1.8	0.9	16.9	17.2	45.9

[1] Survey date as of December 31, 1998; includes updates through December 2000.
[2] Age (in years) is based on the year the vessel was built or rebuilt, using calendar year 1999 as the base year.
[3] Total is greater than the sum because of 4 unclassified vessels and 168 of unknown age; figures include vessels available for operation.
[4] Includes passenger and excursion/sightseeing.
[5] Lighter aboard ship (barge rides on a mother ship).
[6] Includes dry cargo barges that may be open or covered, railcar, pontoon, roll-on/roll-off, container, or convertible.
[7] Includes tank barges that may be double-sided only, double-bottom only, or not elsewhere classified.

SOURCE: U.S. Army Corps of Engineers, Navigation Data Center, U.S. Waterway System Facts, available at http://www.wrsc.usace.army.mil/ndc/wcsc.htm.

Ports and Cargo-Handling Services

In 1999, world waterborne trade reached 5.23 billion metric tons, the 14th year of consecutive growth [2], spurring global competitiveness among ports worldwide. U.S. ports that engage in foreign trade, and their strategic global partners, evaluate port operations in order to improve productivity. Landside congestion, intermodal connectors, water depth, and direction and concentration of trade can affect productivity.

Landside access to water ports comprises a system of intermodal rail and truck services [5]. Landside congestion, caused by inadequate control of truck traffic into and out of port terminals combined with the lack of adequate on-dock or near-dock rail access, affects the productivity of U.S. ports and the flow of U.S. international trade. Generally, productivity is difficult to measure. Cargo throughput can be used to measure physical productivity, however, it does not take into account the more efficient use of resources gained from capital investment [1].

The U.S. port industry has invested approximately $21 billion since 1946 on improvements in its facilities and infrastructure—about one-third of that total (approximately $6.6 billion) was invested between 1995 and 1999. Types of investment include new construction and modernization/rehabilitation. In 1999, new construction accounted for two-thirds of the total expenditures. Since 1994, the U.S. Pacific regions accounted for more than 50 percent of the annual investments and the majority of this investment was in the South Pacific region [4]. In the 1970s and 1980s, the North Atlantic region ranked highest in the level of total industry investments.

Changes in vessel design impact access to both landside and waterside services. For example, container vessels have increased in size and capacity, which, in turn, drives a need for adequate transshipment hub and feeder ports. Hub ports must have large capacity cranes, deep water, a large amount of backup land, and direct intermodal connections. The top ports in U.S. foreign trade are deep draft (with drafts of at least 40 feet) [3]. The majority of containerships with capacities greater than 5,000 20-foot equivalent units (TEUs) call at ports in the U.S. Pacific region (table 1).

Imports exceed exports in maritime foreign trade, particularly in the container trade. Containers entering the United States are full, but the amount of exported cargo is not enough to fill the containers for a return trip. As a result, empty containers are stacked at port terminals or intermodal transfer facilities in increasing numbers. Moreover, U.S. container trade is increasingly concentrated (see pages 121 to 122 for more discussion of container trade). Today, Long Beach and Los Angeles are the top U.S. container ports. The concentration of port activity in the U.S. container trade has increased since 1998, so that the top 10 ports in the trade handle more than 80 percent of total TEUs (table 2).

Sources

1. Robinson, Dolly, Measures of Port Productivity and Container Terminal Design, *Cargo Systems,* April 1999.
2. United Nations Conference on Trade and Development, *Review of Maritime Transport 2000,* Report by the UNCTAD Secretariat (New York, NY: United Nations, 2000).
3. U.S. Department of Transportation, *The Maritime Transportation System: A Report to Congress* (Washington, DC: 1999).
4. U.S. Department of Transportation, Office of Intermodalism, *The Impacts of Changes in Ship Design on Transportation Infrastructure and Operations* (Washington, DC: February 1998).
5. U.S. Department of Transportation, Maritime Administration, *U.S. Port Development Expenditure Report* (Washington, DC: December 2000).

Table 1
Top 15 U.S. Containership Port Calls, by Vessel Size: Calendar Year 1999
Vessels engaged in U.S. foreign transportation[1]

Port	All vessels	Capacity of vessel (20-foot equivalent units) <2,000	2,001–3,000	3,001–4,000	4,001–5,000	>5,000
New York, NY	1,983	465	710	575	227	6
Charleston, SC	1,458	352	566	298	236	6
Long Beach, CA	1,256	307	246	357	168	178
Los Angeles, CA	1,207	429	208	220	294	56
Oakland, CA	1,110	123	291	405	183	108
Norfolk, VA	1,105	155	411	394	139	6
Miami, FL	745	347	244	154	0	0
Seattle, WA	638	157	180	175	57	69
Houston, TX	623	346	169	58	50	0
Savannah, GA	590	144	156	264	26	0
New Orleans, LA	434	297	119	18	0	0
Port Everglades, FL	412	297	63	0	52	0
Baltimore, MD	396	192	123	30	51	0
Tacoma, WA	376	33	105	83	30	125
San Juan, PR	337	307	30	0	0	0
All other ports	2,016	1,176	569	95	172	4
Total all U.S. ports	**14,686**	**5,127**	**4,190**	**3,126**	**1,685**	**558**
Top 15 as a percentage of total	**86**	**77**	**86**	**97**	**90**	**99**

[1] Containerships 10,000 deadweight tons and above.

SOURCE: U.S. Department of Transportation, Maritime Administration, *U.S. Vessel Movements,* 1999, available at http://www.marad.dot.gov/Marad_statistics/index.html.

Table 2
Top 10 U.S. Container Ports: 2000
(thousands of 20-foot equivalent units)

Port	1992	1993	1994	1995	1996	1997	1998	1999	2000
Los Angeles, CA	1,639	1,627	1,786	1,849	1,873	2,085	2,293	2,552	3,228
Long Beach, CA	1,356	1,543	1,939	2,137	2,357	2,673	2,852	3,048	3,203
New York, NY	1,294	1,306	1,404	1,537	1,533	1,738	1,884	2,027	2,201
Charleston, SC	564	579	655	758	801	955	1,035	1,170	1,246
Oakland, CA	746	772	879	919	803	843	902	915	989
Seattle, WA	743	781	967	993	939	953	977	962	959
Norfolk, VA	519	519	570	647	681	770	793	829	851
Houston, TX	368	392	419	489	538	609	657	714	733
Savannah, GA	387	406	418	445	456	529	558	625	720
Miami, FL	418	469	497	497	505	624	603	618	683
Total top 10 ports	**8,035**	**8,394**	**9,534**	**10,271**	**10,486**	**11,779**	**12,553**	**13,459**	**14,813**
Top 10 as a percentage of total	**76%**	**69%**	**72%**	**77%**	**71%**	**76%**	**81%**	**81%**	**83%**
Total all ports	**10,583**	**12,238**	**13,173**	**13,328**	**14,794**	**15,556**	**15,556**	**16,564**	**17,938**

SOURCE: Journal of Commerce, Port Import/Export Reporting Service (PIERS), various data files.

Airport Runways

In general, U.S. airport runway pavement is in good condition. When it is deteriorated, runway pavement can cause damage to aircraft turbines, propellers, and landing gear, and may result in runway closure. To prevent major problems, runway pavement requires regular maintenance to seal cracks and repair damage as well as a major overhaul every 15 to 20 years [1]. The U.S. Department of Transportation, Federal Aviation Administration (FAA), inspects runways at public-use airports and classifies runway condition as good (all cracks and joints sealed), fair (mild surface cracking, unsealed joints, and slab edge spalling), or poor (large open cracks, surface and edge spalling, vegetation growing through cracks and joints).

Airport runway quality improved from 1986 to 1999 (table 1). At the over 3,000 airports listed in the FAA's National Plan of Integrated Airport Systems (NPIAS), runways in fair or poor condition dropped from 39 percent in 1986 to 28 percent in 1999. Those in good condition rose from 61 percent to 72 percent. At commercial service airports, a subset of the NPIAS, only 2 percent of runways were in poor condition in 1999, but the percentage in poor or fair condition—22 percent—has remained the same since 1986. Overall, however, commercial airport runways remain in better condition than other NPIAS airports.

Table 1
U.S. Airport Runway Pavement Conditions: 1986 and 1999

	1986	1999
NPIAS[1] airports, total	**3,243**	**3,344**
Condition (%)		
Good	61	72
Fair	28	23
Poor	11	5
Commercial service airports,[2] total	**550**	**547**
Condition (%)		
Good	78	78
Fair	15	20
Poor	7	2

[1] The Federal Aviation Administration's (FAA) National Plan of Integrated Airport Systems (NPIAS) is composed of all commercial service airports, all reliever airports, and selected general aviation airports. It does not include over 1,000 publicly owned public-use landing areas, privately owned public-use airports, and other civil landing areas not open to the general public. NPIAS airports account for 100% of all enplanements and serve 91.5% of all aircraft (based on an estimated fleet of 200,000 aircraft). In 1997, there were 14,961 non-NPIAS airports.

[2] Commercial service airports are defined as public airports receiving scheduled passenger service and having at least 2,500 enplaned passengers per year.

NOTE: Data are as of January 1 of each year. Runway pavement condition is classified by FAA as follows:
Good: All cracks and joints are sealed.
Fair: Mild surface cracking, unsealed joints, and slab edge spalling.
Poor: Large open cracks, surface and edge spalling, vegetation growing through cracks and joints.

SOURCE: Various sources as cited in U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics 2000* (Washington, DC: 2001).

Source

1. U.S. Department of Transportation, Federal Aviation Administration, *National Plan of Integrated Airport Systems (1998-2002)* (Washington, DC: 1999).

Highway Conditions

Overall, in 1999, 44 percent of the nation's roads were classified as being in good or very good condition and 17 percent as mediocre or poor; the rest were classified as fair (table 1). The generally poorer condition of urban roads, as compared with rural roads, can be attributed to the higher levels of traffic they carry. Since 1993, the condition of all roadways shows only modest improvement with rural areas outpacing urban areas [1].

In 1999, about 30 percent of urban Interstates were in poor or mediocre condition, as measured using Interstate standards (which are higher than standards for other types of roads). By contrast, only 16 percent of rural Interstate miles were classified as poor or mediocre. Despite continued growth in vehicle travel, some improvement can be seen in the condition of urban Interstates since 1993, when more than 40 percent were classified as poor or mediocre (figure 1).

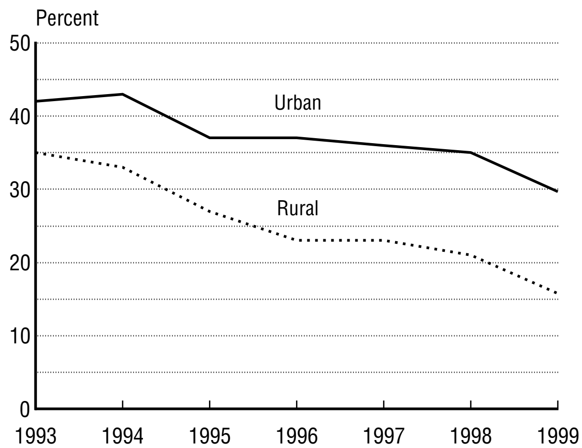
Table 1
Condition of Roads: 1993 and 1999
(Percent)

Type of road	Poor and mediocre	Fair	Good and very good
Urban			
1993	25	42	33
1999	24	39	37
Rural			
1993	19	45	36
1999	14	39	47
Total			
1993	21	44	35
1999	17	39	44

NOTE: Rural does not include minor collectors or local.

SOURCE: U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics* (Washington, DC: Annual issues), table HM-63 for rural major collectors, urban minor arterials, and urban collectors; table HM-64 for all other categories.

Figure 1
Urban and Rural Interstates in Poor or Mediocre Condition: 1993–1999



SOURCE: U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics* (Washington, DC: Annual issues).

Source

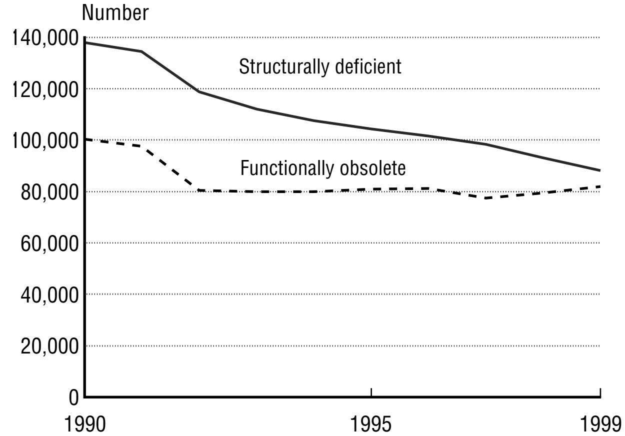
1. U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics* (Washington, DC: Annual issues).

Bridge Conditions

The condition of bridges nationwide has improved markedly since 1990. Of the nearly 600,000 roadway bridges in 1999, about 29 percent were found to be structurally deficient or functionally obsolete, compared with 42 percent in 1990. About 15 percent of *all* bridges were structurally deficient and 14 percent functionally obsolete in 1999 [1]. Structurally deficient bridges are those that are restricted to light vehicles, require immediate rehabilitation to remain open, or are closed. Functionally obsolete bridges are those with deck geometry (e.g., lane width), load carrying capacity, clearance, or approach roadway alignment that no longer meet the criteria for the system of which the bridge is a part. Overall in the 1990s, there was a greater reduction in the number and share of structurally deficient bridges than those deemed to be functionally obsolete (figure 1).

Overall, bridges in rural areas suffer more from structural deficiencies than functional obsolescence, whereas the reverse is true in urban areas (see map and table 1). Nearly one-quarter of bridges in rural areas that support local roads were structurally deficient and one-fifth of urban Interstate bridges were functionally obsolete in 1999. Nevertheless, a large number of both structurally deficient and functionally obsolete bridges support local roads in rural areas [1].

Figure 1
Deficient Bridges: 1990–1999



SOURCE: U.S. Department of Transportation, Federal Highway Administration, Office of Engineering, Bridge Division, National Bridge Inventory database, available at http://www.fhwa.dot.gov/bridge/britab.htm, as of Oct. 27, 2000.

Source

1. U.S. Department of Transportation, Federal Highway Administration, Office of Engineering, Bridge Division, National Bridge Inventory database, available at http://www.fhwa.dot.gov/bridge/britab.htm, as of Oct. 27, 2000.

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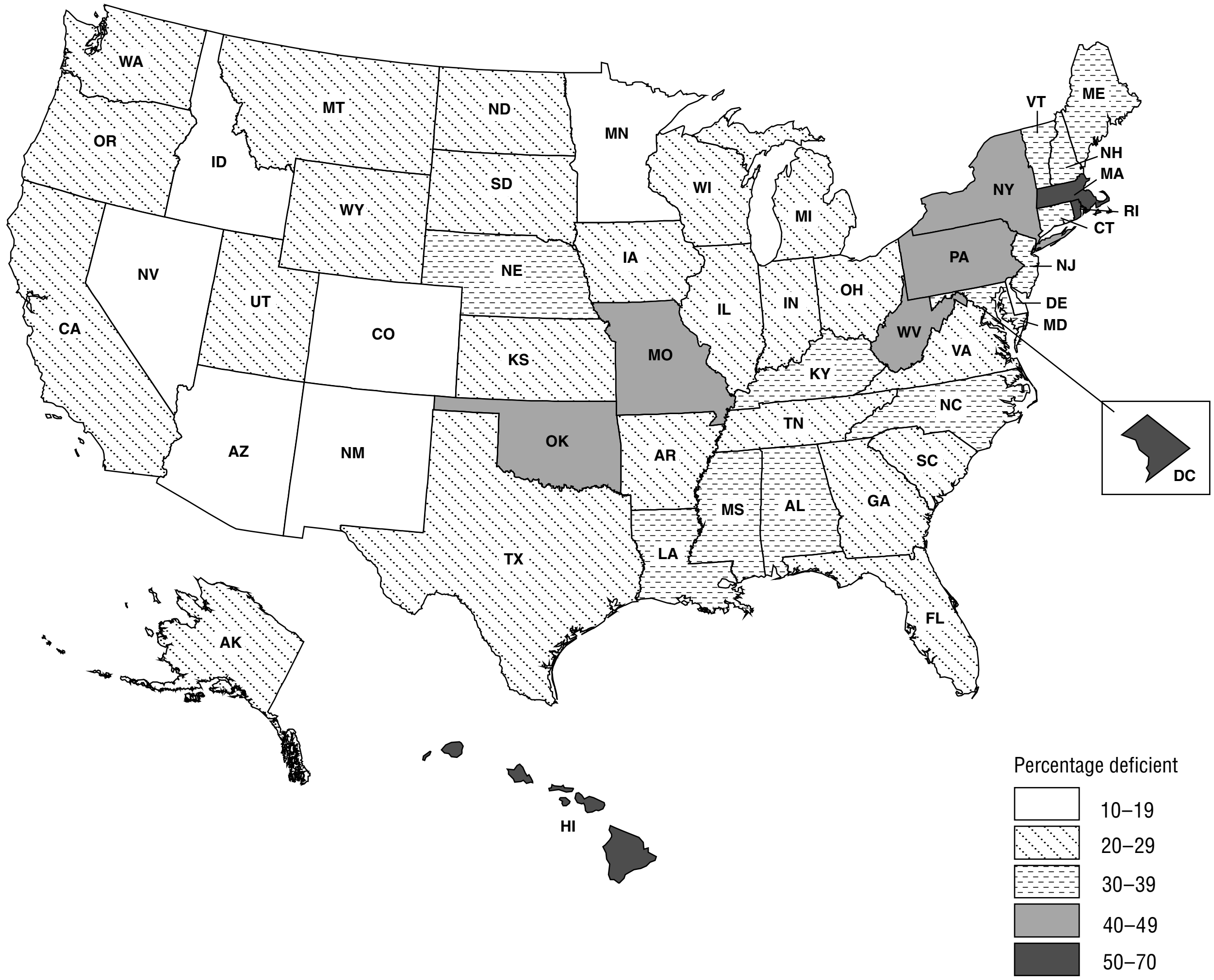
Bridge Condition by State: 1999



SOURCE: U.S. Department of Transportation, Federal Highway Administration, Office of Engineering, Bridge Division, National Bridge Inventory database, available at http://www.fhwa.dot.gov/bridge/britab.htm, as of Oct. 27, 2000.

Table 1
Bridge Conditions by Functional Class: 1999

	Not deficient		Structurally deficient		Functionally obsolete	
Type of roadway	Number	Percent	Number	Percent	Number	Percent
Rural						
Interstates	23,021	84	1,098	4	3,395	12
Other principal arterials	29,317	83	2,305	7	3,734	11
Minor arterials	30,656	79	3,581	9	4,612	12
Major collectors	73,354	77	11,979	13	10,315	11
Minor collectors	34,468	72	7,158	15	5,928	12
Local roads	136,099	65	49,332	23	24,851	12
Rural total	**326,915**	**72**	**75,453**	**17**	**52,835**	**12**
Urban						
Interstates	20,233	73	1,692	6	5,805	21
Other freeways and expressways	11,457	73	928	6	3,347	21
Other principal arterials	16,037	67	2,424	10	5,431	23
Minor arterials	14,126	62	2,576	11	5,992	26
Collectors	9,313	62	1,959	13	3,708	25
Local roads	17,141	68	3,388	13	4,782	19
Urban total	**88,307**	**68**	**12,967**	**10**	**29,065**	**22**
Rural and urban total	**415,222**	**71**	**88,420**	**15**	**81,900**	**14**

SOURCE: U.S. Department of Transportation, Federal Highway Administration, Office of Engineering, Bridge Division, National Bridge Inventory database, available at http://www.fhwa.dot.gov/bridge/britab.htm, as of Oct. 27, 2000.